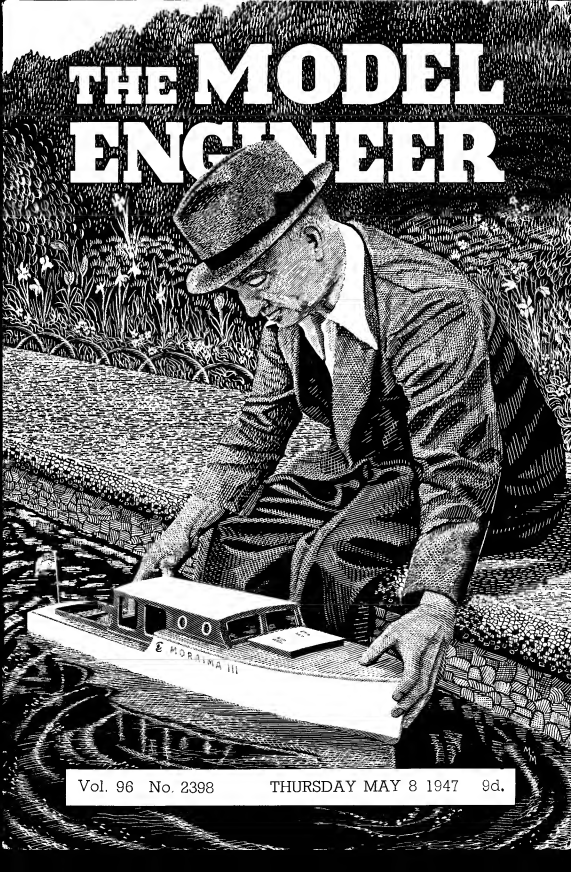
# THE MODEL ENGINEER

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# The MODEL ENGINEER

*Percival Marshall & Co. Ltd., 23, Great Queen St., London, W.C.2*

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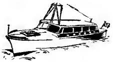




## SMOKE RINGS

### Our Cover Picture

MR. F. G. ARKELL, of the Malden and District Society of Model Engineers, is shown here with his model cruiser "Moraima III," which is equipped with a water-cooled flat twin engine, magneto ignition and twin screws. Together with his late brother, Mr. Arkell has been a keen pioneer of petrol-driven model boats, and one of the first boats with this form of motive power ever entered in an M.E. speed-boat competition was their "Moraima I," built nearly 40 years ago. Mr. Arkell's present-day activities also include the construction of tools and appliances, and electric motors for miniature model locomotives.

### Society Affiliation

THE affiliation scheme which has been tentatively in operation for the past three years through the Society of Model and Experimental Engineers was the subject of a recent meeting at the St. Ermin's Hotel, Westminster, attended by representatives of the 16 clubs at present affiliated to the Society. The advantages and terms of affiliation were fully discussed and a resolution of confidence in the scheme and of loyalty to the S.M. and E.E. was adopted. It was explained that affiliation helped the smaller societies by placing facilities at their disposal, which included the use by members of the Library and Workshop, the supply of copies of the Society's quarterly journal and the testing and certifying of both I.C. engines and steam engines and boilers. Arrangements for inter-club meetings, and a combined *conversazione* meeting was also considered. It was agreed that the fees for affiliation should be adopted as follows :—For societies with a total membership of over 20, £1 1s. per annum; with 20 or less, 10s. 6d. per annum. The capitation fee has been cancelled. Full information regarding affiliation may be obtained from the Secretary, Mr. J. Pacey, 69 Chandos Avenue, Whetstone, London, N.20.

### An Exhibition Prize Pool

AS I have already indicated there will be a special "pool" of money prizes available for allocation by the judges in recognition of special merit or originality in the competition section. This is due to the generosity of a number of friends who desire to extend encouragement to meritorious work, and who instead of specifically indicating types or scales of work to be so recognised, have this year kindly agreed to simplify the work of the judges by giving them a wider discretion in their selection and amount of the appropriate awards. I would like to extend my special thanks to the following donors who have already agreed to participate :—Stuart Turner Ltd. (£3 3s.), Aveling-Barford Ltd. (£3 3s.), The Pritchard Patent Product Co Ltd. (£3 3s.), Mr. Charles Blazdell (£2 2s.), South London Model Engineering Society (£3 3s.), Mr. C. J. Hampshire (£2 2s.), Mr. C. B. Reeve (£2 2s.). The "Frank Moore" Memorial Prizes (£10 10s.), for junior work, offered by Moore and Wright (Sheffield) Ltd. will again be available, and a nice pair of V-blocks from Grey & Rushton awaits some exhibitor of a good workshop job.

### Aviation Scholarships

THOSE of our younger readers who are contemplating a career in one or other of the various branches of aeronautics will be interested to know that there is a Fund in existence for the provision of Scholarships for approved candidates. This is the Spitfire Mitchell Memorial Fund founded in memory of Reginald Mitchell, the designer of the famous "Spitfire" plane which so worthily upheld our cause in the never-to-be-forgotten Battle of Britain. The Fund has some very distinguished sponsors, and last year forty candidates sat for the examinations. Two scholarships of £60, tenable at Southampton University College, are being offered this year. Applications for admission to the examinations should be addressed to the Registrar at the College, but full information regarding the objects and general constitution of the Fund may be obtained from the General Secretary, Miss Mary Pitcairn, 5, Regents Park Road, Gloucester Gate, London, N.W.1.

### The Pinxton Show

I HEAR from Fred Smith that the 20th model exhibition at Pinxton will be held at the Miner's Welfare Hall from May 14th to 17th, the hours being 2 p.m. to 9 p.m. daily. Entry forms for the competitions may be obtained from Mr. Smith who tells me that the Pinxton Society is growing in membership and had a very successful season. His address is Langton Bungalow, Pinxton, Notts.

### Penzance Calling

A NOTE from Mr. W. J. Peters indicates a desire for a local model engineering Society. He would be glad to hear from other readers in his area who are of like mind. His address is 12, Treoveor Terrace, Penzance.

### The Portsmouth Journal

ONE of the most enterprising Club journals I have yet seen has reached me from the Portsmouth Society. This is bound in a very artistic cover in colour, and contains no less than 64 pages packed with club news, and with constructive articles on members' models and items of workshop information. The Editor, Commander L. A. Brown, R.N.V.R., is to be congratulated on an excellent production which I am sure will do much to stimulate interest in the Society, not only among its own members, but among those model engineers in general who are fortunate enough to get a copy. In browsing over its pages I came across what, to me, is I think the most original idea for a model railway track on record. It is related by Mr. H. F. Gage, who says :—"In the closing years of the 19th century a small boy with a toy train badly needed a running track—none was forthcoming so he proceeded to devise one of his own. The soil by the side of the lawn in the garden was of a clayey nature and by running a piece of rolling stock on the flattened damp surface a good impression of a railway track was formed which a sunny day hardened sufficiently for a small train to function. That mud track was the beginning of a model railway career which has not yet terminated." Mr. Gage has spent many years in building locomotives and laying more elaborate tracks, and now possesses one of the most complete layouts in "O" gauge to be found in the Southern counties. I was pleased also to find in the journal a portrait and story about Mr. J. Mendez, still as keen as ever at the age of 78. He is well-known for his examples of model ordnance building for which he has obtained high honours at the M.E. Exhibition. He has lately turned his hand to ship modelling, but I gather that he is also busy on a 40-pounder breech-loading gun with the Moncrieff disappearing mounting. The Society has a strong model power boat section as the result of amalgamation with the Portsmouth Model Steamboat Club, and has also acquired a good deal of tools and material destined for service in a prospective club workshop. Mr. H. A. Handsford, the energetic Hon. Secretary, confides to me that the production of the new journal was a "first-class headache." Even we of THE MODEL ENGINEER know those production headaches, but we warmly congratulate our Portsmouth friends on the results of their editorial adventure.

### Locomotives in Yorkshire

A NOTABLE success has been scored by the West Riding Small Locomotive Society. During March they staged two exhibitions covering model engineering in all its aspects, one show being held at the Central Hall, Bradford, and a few days later a second show at the Corn Exchange, Leeds. Some 200 models were on view, and of these no less than 55 were locomotives in all gauges from $2\frac{1}{2}$ in. to $7\frac{1}{4}$ in. There were over 4,500 visitors at Bradford, in spite of very bad weather conditions, and 12,600 at Leeds. A splendid achievement for a society not yet two years old, and one which speaks volumes for the enthusiasm and energy of the Hon. Secretary, Mr. W. D. Hollings, and his colleagues on the executive. Most societies find one exhibition is quite a handful, but in Yorkshire they plan on a bigger scale with apparent courage and success. The main purpose of the two shows was to raise sufficient funds to finance the construction of the society's outdoor track at Blackgates, and this objective was achieved. I shall look forward with much interest to further news of "live steam" activities in the West Riding.

### A Model Observatory

AN interesting feature of the Olympia Section of the British Industries Fair will be a working model of a new telescope, installed in an observatory. The aim is to present a complete observatory at a reasonable price, adapted to the requirements of amateur astronomers. Another exhibit demonstrating skilled handicraft will be devoted to the processes involved in thermometer making. The Fair will be open from May 5th to the 16th.

Percival Marshall

# AN EXPERIMENTAL BURNER

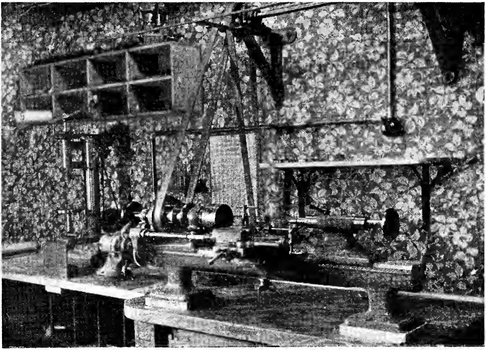
Suitable for a Slow-Combustion Stove for Workshop Heating

*by Alb. Kruck (Zurich)*

*The oil burner with the air deflector*

[It is interesting to learn that the troubles we have recently experienced in this country through the coal shortage are not unknown in Switzerland. One of our readers, Mr. Alb. Kruck of Zurich, faced with the problem of keeping his workshop warm, experimented with oil fuel, and evolved a very satisfactory slow-combustion stove which he thinks may be of interest to fellow model engineers over here. With the milder weather before us this question of heating is not of great urgency at the moment, but, in view of a possible recurrence of difficulties next winter, our readers may like to try out Mr. Kruck's design in advance.—ED., "M.E."]

I KNOW that in England with its own high quality coal production, this type of heating is not a matter of particular importance. For us in Switzerland the position is quite different. Electricity is, of course, available for heating purposes, but in winter time the use of electricity for space heating is permitted only in exceptional cases; also, electric heating is prohibitively expensive. During wartime fuel



*Mr. Alb. Kruck's workshop; on the left is seen the home-made drilling machine*

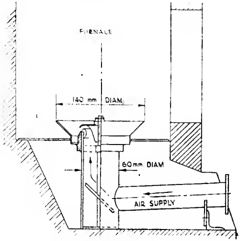



*Fig. 1. Diagram, partly in section, of the successful burner*

was very difficult to obtain, and the small quantities imported were, for obvious reasons, reserved for industrial purposes. For domestic heating only small quantities of wood, peat, and domestic coal of low heating value were available, so that the room temperature nearly always had to remain below 14 deg. C. (about 57 deg. F.). After termination of war, coal imports ceased altogether for a considerable length of time; and subsequent coal imports were again diverted to our very busy industries. However, surprisingly large amounts of petrol, kerosene, and fuel oil became available. Many a shut down central-heating plant designed for oil-firing could, therefore, be started up again this winter. But what about the others who are dependent upon wood and coal? Are these to freeze another winter?

Since small oil burners for slow combustion stoves are not available here, as far as I know, I began—unfortunately too late—to carry out some experiments of my own.

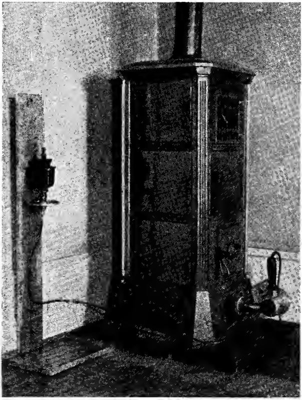
I had re-equipped my workshop in the spring of 1946. My small lathe (55/100 mm.) was replaced by a larger one of 90/350 mm. This enabled me to make myself all the parts required for my experiments.

My first experiment was conducted with the use of a small cast-iron bowl of 50 mm. diameter, which was filled with kerosene and then placed upon the grate of the stove. The stove became quite warm after 0.15 litres of kerosene had been consumed.

I thereupon built a simple burner bowl of 110 mm. diameter of wrought-iron with bottom air supply piping. The free parts of the grate were covered with sheet iron. The oil was supplied from below directly into the bowl, the supply being controlled by an old drip-oiler. I soon found that the burner did not work well, as the chimney draught was insufficient on the fifth floor. Combustion was poor and the flame developed a lot of soot.

Subsequently I designed and built an oil burner with blower. However, I had no information regarding the amount of oil burnt per unit area of oil surface. The first burner was therefore found to be too large. A smaller burner as shown in the photograph and Fig. 1, finally proved successful. For the time being I made an electric hair dryer serve as blower. Its power consumption was 10 Watt when operating on 110 volt (instead of its normal voltage of 220 volts). The oil supply was again controlled by the aforementioned drip-oiler. Combustion was now soot and smoke-free. I soon found that the utilisation of the fuel oil was better than in the previous experiments conducted with natural draught. Previously the stove did not get really hot with two fillings of the drip-oiler, but now it gets quite hot with one filling of approximately 0.25 litres.

The photograph below shows the experimental installation. On the left the drip-oiler is seen to be attached to the wall, while the hair dryer is visible on the right hand side. Diagram Fig. 2 shows the temperature characteristics and the



*The experimental installation*

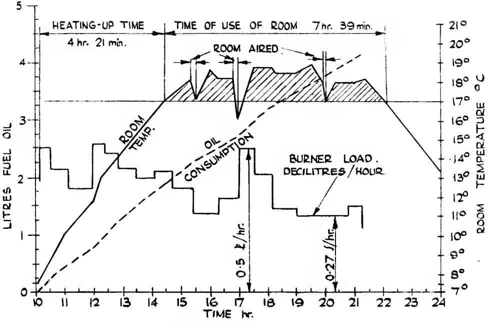



*Fig. 2. Diagram showing the temperature characteristics and oil consumption*

oil consumption, referring to a test conducted while the outside temperature − 2 to − 5 deg.C. in the evening, with a stiff northerly wind blowing against the windows. I may add that the room in question is directly under the attic, only on one side is the room adjacent to a heated room. The room below on the next floor was not heated during the test.

It is intended to replace the electric hair dryer by a silent fan (home made), and to replace the drip-oiler by an accurate needle valve with a dry tank and an over-flow reservoir.

What the fire inspector will say I do not know as yet; when the plant is ready I will report it to him. What I fear most are the official dues.

It may be of interest to compare this plan with the firing system of my steam-boat mode (M.E. June 2nd, 1938). While it would be possible to keep the room temperature stationary at 18 deg.C. with a fuel oil consumption of approximately 0.3 litres, the steam boat model could operate for only 30 minutes with the same amount of fuel. But it must be considered that the small boiler of the vessel is highly rated (small boiler weight) and that fuel utilisation is therefore much less effective. One can say that the construction of a small oil burner is well within the bounds of possibility in a small workshop.

# A One-Man Show

THE showcase in the Cartwright Memorial Hall Museum, Bradford, which is usually filled with models lent by the City of Bradford Society of Model and Experimental Engineers, now contains thirteen models representative of the work of Mr. Amos Barber, who founded the Society in 1908.

The display shows Mr. Barber's versatility as a model-builder. Smallest of the models is that of a 1-c.c. petrol engine, which contrasts with an exquisite scale model of a traction engine built over forty years ago. Of the four guns exhibited, three are now of almost historical interest—a "Long Cecil" field gun used in the Boer War, a Hotchkiss quick-firing gun of about the same period, and a 10-in. bomb-thrower.

Mr. Barber's first model was a horizontal steam engine which he began to build fifty-eight years ago, at the age of thirteen. This has since been rebuilt three times, and is included in the collection.

# A MODEL 6in. NAVAL GUN

*by S. A. Walter*

*A three-quarter view, showing the sighting gear*

As long as I can remember I was always interested in models and model-making, but circumstances prevented my indulging myself. After demobilisation from the first world war, I lived in a top flat, and quickly gained the impression that elaborate models cannot easily be constructed on a corner of the scullery table, with the aid of an egg-whisk (slightly faulty), the heel of a shoe for a hammer, a large chipped screw-driver, and the top of the gas cooker as an anvil.

My model-making activities started seriously about 1936, when the craving to mutilate chunks of metal became of urgent and pressing importance, and something had to be done about it.

By this time we were living in a house, and my glittering eye had fixed on the spare bedroom. Establishing a bridgehead and consolidating my position, I took possession—and since then have always been sorry I didn't have the main bedroom, which would have made a far better workshop. After all, one can sleep anywhere, but it is of vital importance—as all model engineers will agree—to have plenty of room for the important craft of model making.

My wife and I agreed fully and completely on this momentous matter, so I still retain the small room, which is about 11 ft. by 7 ft. Admittance is by the south entrance, and the heavy machine shop is immediately behind the door. Standing on the same spot, but facing in the opposite direction, one is in the combined fitting and pattern shop, which, when necessary, is the drawing office as well. In the distance can be seen the toolroom and experimental department (known in the trade as "the nut house"). These can be reached in two short paces due north. At arm's length behind the toolroom lies the stores—a collection of various tins accumulated during the palmy days when the price of tobacco didn't include the cost of a modern cruiser. These are housed in a wooden structure which originally encased about 1,000 oranges and is supported precariously on the junk-box (or should I say the reclamation department?).

The heat treatment, brazing and soldering shops are fully mobile, and when in full production are mounted in a large tray on the kitchen sink, some three feet from the only live gas point in the house. They turn out their best work when my wife has gone to the pictures.

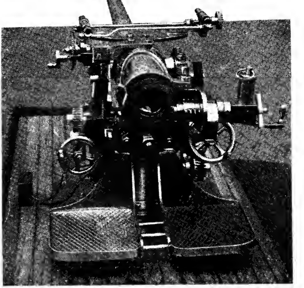
Accounts of several of my models have appeared from time to time in THE MODEL ENGINEER, and the gun, which was fully described in the issue for January 27th, 1944, was extensively altered last year to make it more like a 6-in. Mk. VII naval q.f. gun. The former single sight has been replaced with twin sights on completely new frames, and a range-finder made from small clock gears added. The shoulder rest is now fully adjustable, and a duplicate is also mounted on the right-hand side of the gun. The footplates and brackets are new, and the recoil cylinder has been modified.

Other new parts include a pistol-grip firing key, gunmetal fire-control box, teak battery box with leads, elevating hand-wheel, shoulder protection shield on the breech, oilcups, etc.; the rivets in the conical base have also been replaced by others with smaller heads.

None of these calls for particular comment except the chequered footplating, about which I have had many enquiries.

As readers know, the usual way to represent this type of footplating in models is to score a

plate with diagonal lines so that the diamonds are separated by narrow grooves, which is exactly the reverse of full-size practice. I wanted a true replica; after various schemes of making hardened dies and trying to work up the form under pressure in a vice, etc. (the job *had* to be done in my workshop) I eventually thought of an idea that might work. A trial on a piece of scrap steel plate gave excellent results, and I went ahead with the final article.



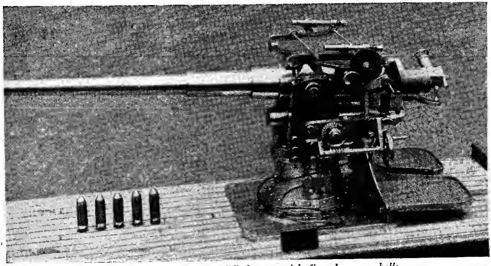
*The gun from the control platforms; the interrupted breech threads can be clearly seen*

It had occurred to me that I might etch the diamond pattern, but the time-honoured method of covering the plate with wax and scraping the lines away would have produced the wrong effect; so all I did was to reverse the process.

After cleaning a piece of ⅛-in. sheet steel with fine emery cloth I drew the lines on the surface of the metal, using varnish in a draughtman's ruling pen for the purpose. When these were finished and had been thoroughly dried by gentle heat, the whole piece was immersed in strong sulphuric acid, to which had been added about 10 per cent. of water. This was allowed to cool before use, as the addition of the water had, of course, generated much heat. After a couple of hours pickling, the diamonds had been etched to a depth of some 0.010-0.015 in., and the plate had then only to be rinsed, cleaned and cut to correct size. The acid naturally attacked any part of the steel which was unprotected, and consequently finished up slightly thinner than ⅛ in.; but this was unimportant.

The raised lines are very clean, not undercut in any way; the final result is good and looks very realistic, just as though it has been rolled in. The effect may be seen in the photographs. I suggest this method to anyone who wishes to make small chequered plating, and make them a present of the idea; I should be pleased to answer any queries through the Editor.

In its new form the gun recently won three first prizes, including the Malden Medal of Merit, in silver. At the moment, I am working on a model Leyland "Cub" fire-engine, an account of which appeared in the March, 1947, issue of *Model Car News*.



*A side view of the modified gun, with five dummy shells*

# RESTORING A BONE MODEL

by Edward Bowness

AS a change from the usual type of bone model made by the French prisoners, captured during the Napoleonic wars, we have recently received particulars and photographs of a bone model of a French lugger. Mr. Laurence Pritchard, M.I.N.A., of Southampton, who has made a careful examination of the model, and on whose report the following particulars are largely based, places the date when it was made as being between 1795 and 1820, with a leaning toward the earlier date.

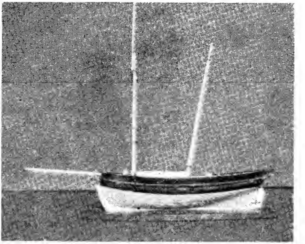


*Photo by*] [*Laurence A. Pritchard*

*The model before restoration*

The model has been carefully restored by Mr. R. Rooney, of Exmouth, various parts which were missing from the hull and decks being made and fitted, and the rigging replaced in its entirety. The restoration of models such as this is work of the greatest importance, calling for a high standard of craftsmanship and entailing a considerable amount of research. A contemporary model, properly restored, is usually more convincing as a record than a new model, though the authenticity of the particulars from which the new model is made may be beyond question. The craftsmanship in models of 100 or more years ago was often of a very high standard. Perhaps they had more time or fewer distractions than we have in these days. Whatever the reason, the work was wonderfully done and the details beautifully finished. However dilapidated an old model may be, if it is correctly proportioned and has been carefully made, it should be put into the hands of a competent restorer, or taken care of until the opportunity occurs of having it restored. There are numberless instances of good models being so damaged through neglect that their restoration is out of the question.

In this particular model the hull is constructed entirely of bone and is 11 in. long overall. It is built on a keel with properly scarphed stem and stern pieces and is planked clinker fashion, which is unusual in a bone model. The lines are very fair and beautifully proportioned, the lovely sweep of the sheer being very noticeable in the side view reproduced herewith. From the headroom in the interior, Mr. Pritchard suggests a scale of about 1/50. Taking it as ¼ in. = 1 foot, the English equivalent, the dimensions of the prototype would be 44 ft. overall, 34 ft. 6 in. length of keel, beam 15 ft. 3 in., and depth to bottom of keel 7 ft. 6 in., and the draft would be approximately 4 ft. 6 in. The keel is slightly curved or rockered throughout its length, which was a characteristic of small sailing craft on both sides of the Channel.

The hull is planked in two kinds of bone, the lower part being white and the topsides a very dark brown. This latter resembles the dark whalebone strips used by dressmakers long ago. This material has also been used for the dark diamonds in the floor of the cockpit. The forward end of the cockpit is a bone bulkhead and has a pair of sliding doors. The well between the main mast and the cockpit is constructed of cedar, and is covered with a removable section of the deck which is made of bone. The well, being made of wood, gives the impression that it may have been used in the model for some utilitarian purpose not intended in the actual ship. In the ship, if she was used for fishing, the well would probably have been used for fish or for storing nets.

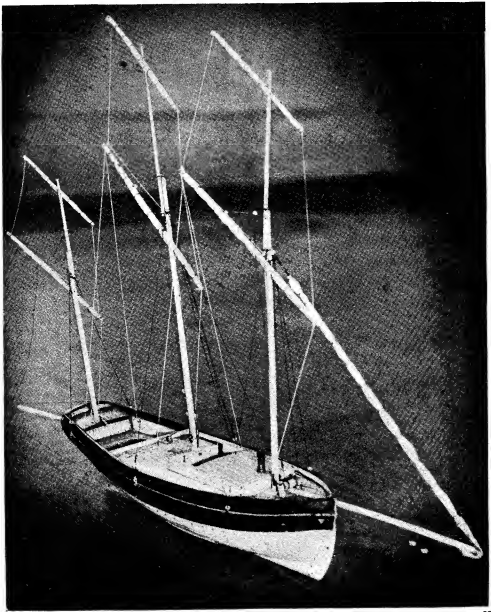
The cabin between the fore and main masts is a most elaborate piece of work, having a diamond pattern floor similar to that in the cockpit, with settees and lockers along each side, the top of which extend to the ship's side to form berths. At the fore end of the cabin is the galley stove or range, very well made from sheet copper. It is complete, even to ash tray and fire bar. Everything in the cabin, except the stove, is made of bone. The galley chimney was missing, but has been replaced by Mr. Rooney.

The after portion of the cabin roof is missing and has not been replaced, probably to facilitate the inspection of the interior fittings of the cabin.

Forward of the foremast is a small bone wind-

lass with brass bands on each end of its short drum, and on its port side is fitted a minute ratchet and pawl. The bilge pump is located aft of the main mast and passes through the floor of the well. The arm and plunger of the pump were missing but have been made and fitted by Mr. Rooney. The tiller also was missing and has now been replaced. These small fittings were made in silver, as this was the metal used in making the mast caps and rudder hinges, and these were still in position in the model. The rivets used in planking also appear to be made of silver.

The rigging was based on an illustration in F. C. Bowen's book, "The Sea: Its History and Romance," and on plate 49 of the same writer's book, "From Coracle to Clipper." Our readers will be interested to compare it with that shown in the articles on the smuggling lugger, by Edgar J. March, in recent issues of THE MODEL ENGINEER. In the restorations the shrouds were made single as the chain plates on the model were single in each case. Mr. Rooney is to be congratulated on having made a good job of a very interesting model.



*A bone model of a French Lugger*

# *COMPRESSION-IGNITION ENGINES

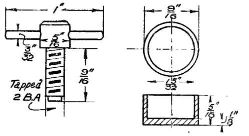
## by " Battiwallah "

THE compression adjusting piston is shown in Fig. 7, together with the adjusting screw which fits into the cylinder cover.

The piston is machined with a chucking piece first turned on it in the same way as was explained for the main piston. It is similarly lapped to finishing size, the same lap being used. It must be finished to the merest fraction of a mil. larger in diameter than the main piston, because the compression adjusting piston must be a good push fit in the cylinder. If it is not, then it will just follow the main piston up and down and be of no use.

There is no need to case-harden the compression adjusting piston.

The compression adjusting screw needs no comment, other than that when it has been tried on the assembled engine, it should be reduced to a length such that when it is screwed right down, the compression adjusting piston just clears the main piston. The risk of bending the connecting-rod should the screw be right home is thus eliminated and one can also use it as a rough gauge to assess the compression space.




COMPRESSION ADJUSTING SCREW & PISTON

*Fig.* 7

### Cylinder Cover

In Fig. 8, the details of the cylinder cover are shown. It is turned from a piece of $1\frac{3}{8}$-in. or $1\frac{1}{2}$-in. aluminium bar. Drill the bolt holes to the template made for the cylinder fixing holes in the crankcase (right side up again, of course), before the cooling-fins are formed.

### Carburettor

The general arrangement and the principal dimensions are shown in Fig. 9.

For the induction tube, turn a $\frac{5}{16}$-in.-$\frac{3}{16}$-in. taper $\frac{5}{8}$-in. long on a $\frac{5}{16}$-in. diameter piece of mild steel and reduce a further 1 in. to $\frac{7}{16}$ in. diameter. Drill right through at $\frac{1}{8}$-in. diameter and part off at $1\frac{1}{2}$-in. long. Make a taper D-section reamer $\frac{1}{8}$-in. at the small end and 9/32-in. at the large end, the taper being $\frac{5}{8}$-in. long. Harden and temper it. With this tool open out the bore of the induction tube at the tapered end. File up a piece of iron 3/32-in. thick tapered over $\frac{5}{8}$-in. from $\frac{3}{8}$-in. to $\frac{1}{8}$-in. wide and round off the edges. This makes a former for flattening out the tapered end of the induction tube. File up the bolting flange and slot it so that the flattened end of the tube fits tightly in it. Turn up the piece which receives the jet adjusting crew from mild steel, and screw the male threads; drill the tapping holes but do not tap them until after brazing. Drill through radially at $\frac{3}{16}$-in. for the induction tube. Clean and flux the joints, and braze up. The jet and adjusting screw threads can now be tapped and the job cleaned up.

The jet adjusting screw can be made from a piece of $\frac{1}{2}$-in. dia. mild steel, in one piece, or in parts as shown in the sketch. A gramophone needle is ideal for the taper pin; drill a hole in the end of the screw to suit the needle and solder it in. The adjusting screw must be of a length that, when the jet is fully closed, the thread does not project into the induction tube.

The jet is a one-piece component, made from $\frac{1}{4}$-in. hexagon or round brass—flatted on two sides for tightening up, if the latter. The screwed end should be pointed at the jet orifice and of such length that the jet projects about 1/32 in. into the induction tube. Drill through with $\frac{1}{16}$-in. drill to within $\frac{1}{8}$-in. of the screwed end, and then reverse in the chuck, and drill with No. 70 drill. Reduce the plain part of the jet to $\frac{1}{8}$-in. or less for lightness, if you can safely do so.

### The Tank and Cover

The tank and its cover are made from aluminium bar; rather wasteful for the tank, but it is hardly worth while going to the trouble of making a casting. The sketch shows a screwed fixing for the tank. In the absence of screw-cutting arrangements on the lathe, a stirrup arrangement, with lugs on the cover to secure the tank, is easily devised.

This completes the making of all the engine parts, except the fitting for securing to the shaft whatever it is the engine is required to drive, and the various screws and bolts.

As a mounting and load-absorbing device will be needed for testing, these may as well be made at this stage, so that they are ready when the trials are to be made.

A block of hardwood about $1\frac{1}{2}$-in. square, grooved out to receive the crankcase and about 9-in. long, is a suitable mounting; the groove should be at one end of the block. The block can be firmly held at the other end in a vice.

A 10-in. propeller, made from 1-in. by $\frac{1}{16}$-in. steel is as good a device as any for absorbing

*Continued from page 511, "M.E.," April 24, 1947.

load, and it provides a convenient means for starting the engine. It needs but little pitch. With a $\frac{5}{16}$-in. hole in the centre, it can be held between two nuts on the end of the shaft, if this has been screwed ; if a taper has been provided, then a suitable boss must be made for the test-prop. I do not recommend a wooden propeller for testing, because the engine will be a little stiff until it has had a good run, and the inertia of a wooden propeller will be too small to

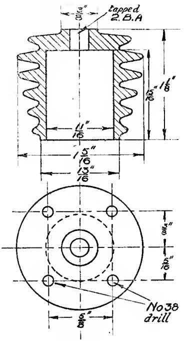



*Fig. 8. Cylinder cover and cooling-fins*

enable one to give the engine a vigorous flick round for starting.

If the engine is intended for boat-propulsion, it will doubtlessly be provided with a flywheel and a grooved pulley for a starting-string. Although the engine can be started with the latter, no means of absorbing load are afforded unless special provision is made.

### Assembling

There are a few points on which a constructor can profitably be refreshed if he is not accustomed to this kind of job.

The first is the need for absolute cleanliness while doing the work. I prefer to lay out the parts on a sheet of clean paper, have clean tools, all filings and dust swept from the bench, and a piece of clean rag handy. (Nowadays the latter has to be " boned " from the domestic " snips " department, surreptitiously.)

Use strong paper washers, and an oil and petrol-resisting cement such as Heldite for the gas-tight joints of the back cover, the cylinder flange, and the carburettor boss. Gold size is not much good, for the ether in the fuel dissolves it. On no account use plumber's jointing ; that also dissolves, and the abrasive it contains might find its way to the vital parts. Shellac varnish is fairly good but it softens with heat.

Make sure that every vestige of lapping compound is removed from the transfer port ; it is a nice little trap.

The cylinder and the cover are secured to the crankcase by long 3/32-in. studs nutted at the top of the cover.

When threading the cylinder over the piston, do not forget that tallow and not oil is the lubricant.

A check of the accuracy of the essential dimensions is that at dead top centre, the bottom of the piston should be level with the top of the inlet port and at dead bottom centre the top of the piston should be level with the bottom of the exhaust ports.

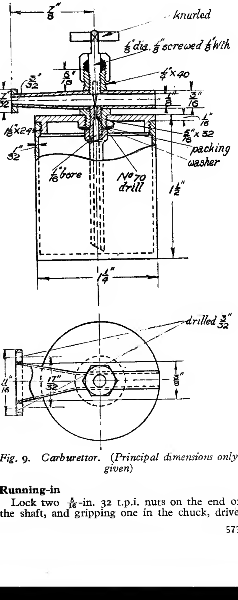



*Fig. 9. Carburettor. (Principal dimensions only given)*

### Running-in

Lock two $\frac{5}{16}$-in. 32 t.p.i. nuts on the end of the shaft, and gripping one in the chuck, drive

the engine at a very low speed with the compression-piston slacked right off. Put a little clean tallow on the piston every now and then with a matchstick and continue to turn over the engine slowly, until it feels somewhat easier. It need hardly be said that the crankshaft-bearing, the crankpin, and the gudgeon pin should have been oiled when the engine was being assembled.

When the engine does turn easier, give it a good priming with medium-grade motor engine oil through the induction tube and step up the running-in speed to about 100 r.p.m. Give it about half-an-hour's running at that speed, after which it should have eased considerably more. It will not hurt to follow up with another half-hour's running at a good speed—400-500 r.p.m. At this speed the exhaust will pop quite healthily if the piston is the fit it should be; the heat generated by compression both in the cylinder and the crankcase will warm up the engine quite considerably.

The times given for running-in are arbitrary; what matters is that the process should commence at a very slow speed, which can be increased as the engine eases, and it must be continued until the engine feels reasonably free. The great moment has then arrived when it is ready for trials.

### Testing

Firstly, drain off through the induction tube the surplus lubricating oil remaining in the crankcase after the running-in process, the piston being on top centre.

Secondly, mix about ¼-pint of fuel to the proportions given in the introductory notes of this series of articles, and keep it well corked, for the ether will soon evaporate away if not. A graduated medicine bottle is a convenient combined measure and storage vessel. Before filling the fuel-tank, ensure that the jet is clear.

Screw down the compression adjusting screw so that a good compression can be felt as the engine is turned with the testing-propeller. Prime the crankcase by stopping up the air intake with the finger; give the engine not more than two priming turns or it may be flooded and will not start. Try this operation with the jet screw opened about one-and-a-half turns. Now give the test propeller a vigorous flick and if you have been lucky enough to hit upon the correct jet and compression settings, the engine may fire. Repeat the propeller flicking, increasing the compression until either the exhaust pops or the propeller reverses. The first is a sign that the adjustments are near; the second means that the compression is excessive. If, after a while, there is no sign of life in the engine, give it another priming.

It is a matter of trial to find the correct settings for the jet and the compression. By making the trials systematically, and with gradual changes between each, the correct settings will be found.

If you are so unlucky as to be a long time doing this, the chances are that the engine will have been over-primed, in which case, it can be drained via the induction tube. Also, it is as well to try starting with the jet screw closed right down. This clears excessive fuel

If, when the engine is running, it emits a clanking noise, the compression is too great, ease off the adjusting screw until this noise ceases.

When you have once found the settings at which the engine runs sweetly, let it run for a while without altering the adjustments. There will be plenty of time later to tune up to the best settings. Incidentally, these will vary with the proportions of the fuel constituents.

Another starting tip is to put a spot of medium-grade motor oil on the piston if the engine is obstinate in starting. Repeatedly unsucccessful efforts to start usually mean that the lubricant on the cylinder wall is very diluted and the compression weakened; the extra oil will restore the compression.

### Conclusion

Throughout these notes I have endeavoured to deal with the essential details of construction of compression-ignition engines in a manner to be of assistance to those who are unfamiliar with the making of small engines of the internal combustion variety. I have described methods which I have used with successful results in my own very ordinary "modeller's workshop." No claims are advanced that the methods described, or the design, are the last word; I would not be so presumptive, for there are those whose daily task is precision engineering, and who, no doubt, can give much better advice for obtaining the very close fit for the piston and cylinder, which is so essential for the satisfactory performance of compression-ignition engines. Likewise, there are those whose hobby for years has been small petrol engine construction; they also are familiar with amateur's methods for obtaining precision fits.

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## Mr. Westbury "Goes" to Coventry

THE highlight at a recent meeting of the Coventry Model Engineering Society was Mr. Westbury's visit and lecture. Attended by almost a full quota of society members, together with two local aero society representatives and several other visitors, the evening was undoubtedly a success. Our sincere thanks are due to Mr. Westbury for paying us this visit and giving us an insight into the problems and trials encountered over the last twenty years in bringing the miniature petrol engine to its present state of reliability. The examples of his work which he brought with him were examined with interest.

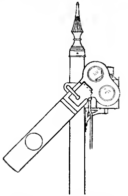
At this same meeting, Mr. Westbury presented to Mr. Thornton, one of our members, a cheque as a prize won by him at the Leicester Exhibition for an excellent replica of a Bradford tramcar. This was also on show at the meeting, and the beautiful workmanship put into it was much admired and envied.

# LOCOMOTIVES WORTH MODELLING

## by F. C. Hambleton

### No. 22—Midland Railway "Princess of Wales"

WHILE *Edward Blount* and S.E.R. No. 240 were indulging in those little sports meetings at Sens in the early part of 1890, the Midland exhibit, No. 1853, was settling down to regular work on the main line from St. Pancras to the North. She was soon assisted by half-a-dozen sisters, Nos. 34, and 1863-7, and another thirty-five were in service before the end of 1893. The latter set were provided with spiral springs underneath the driving axlebox, which, in the opinion of admirers of the class (and they were many) considerably enhanced their appearance. Another slight difference was the raising of the main frames a little above the footplate level stretching between the smokebox and driving splashers. These engines were numbered rather irregularly, but as you, good locomodeller, may be the lucky possessor of photos of some of these fine engines, it may aid the fascinating game of identification if the list is quoted *in extenso.* Here it is, then: 1868-1872, 8, 20, 122, 145, 24, 33-6, 38-9, 4, 16, 17, 94, 97-100, 129, 133, 149, 170-178.

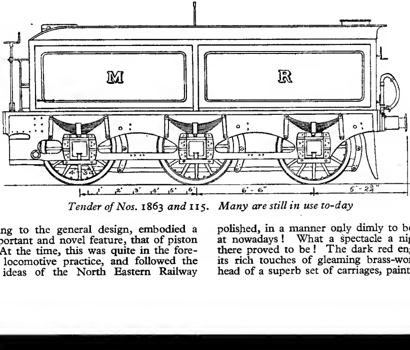


*The Midland signal-lamps with their large reflectors gave a splendid splash of deep green for "right away!"*

The next ten engines, Nos. 179-183, 75-79 and 88, were produced in 1893 and 1896, and although engines. These ten singles could be easily identified by yet another increase in the height of the main framing immediately below the smokebox. The cylinders also were larger, being 19 by 26 inches.

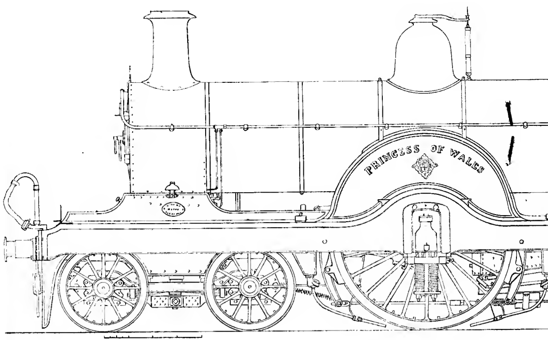
But there were more excitements in store for the Midland enthusiasts. Hardly were these engines completed when there appeared, from Derby works in 1896, a real beauty. This was No. 115, and although to the same designs as before, the enlarged dimensions resulted in a locomotive which entirely won the hearts of all beholders. The big 7 ft. 9 in. driving wheels, and the boiler pitched up to 7 ft. 10 in. above rail level, did indeed have the effect of making an extremely fine looking locomotive. The cylinders, too, were increased to 19½ by 26 in., and the pressure raised to 170 lb. Eight-inch piston-valves, inclined downwards below the cylinders, distributed the steam. No. 115 and 116 arrived in 1896, followed by 117-119 in the next year.

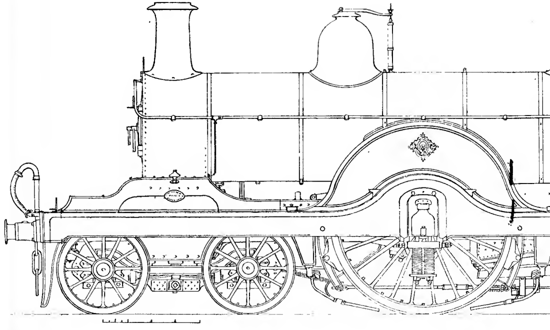
How we used to love to watch these splendid engines steaming in and out of St. Pancras—that wonderful terminus with its fascinating one-span roof of graceful curve, under which everything was spick and span, painted and

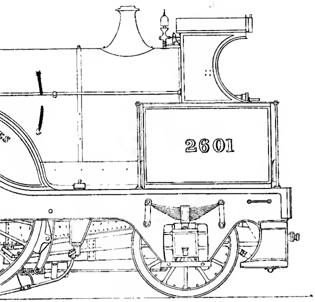


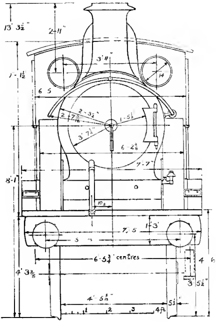

*Tender of Nos.* 1863 *and* 115. *Many are still in use to-day*

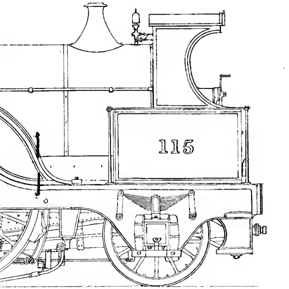
conforming to the general design, embodied a most important and novel feature, that of piston valves. At the time, this was quite in the forefront of locomotive practice, and followed the modern ideas of the North Eastern Railway polished, in a manner only dimly to be guessed at nowadays! What a spectacle a night scene there proved to be! The dark red engine with its rich touches of gleaming brass-work at the head of a superb set of carriages, painted in the


PRINCESS OF WALES





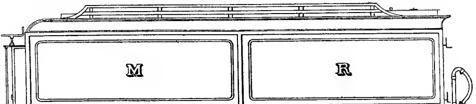






*Above left—Could one wish for a finer locomotive? The M.Ry. exhibit at Paris,* 1900

*Above—This elevation of No.* 2601 *shows the same widths as those of No.* 115

*Left—The* 115 *design was the classic M.Ry. example*



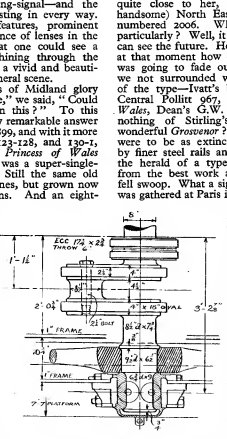

*One of the best designs of the period when bogie tenders became all the rage*

same colour and sharing in the same high degree of finish.

In the darkness at the end of the platform stood the interesting starting-signal—and the Midland signals were interesting in every way. They had many unique features, prominent amongst which was the absence of lenses in the lamps. The result was that one could see a fascinating spot of flame shining through the deep green glass, and giving a vivid and beautiful splash of colour to the general scene.

Oh! those were the days of Midland glory right enough! "Could there," we said, "Could there be anything finer than this?" To this question Derby gave the very remarkable answer of "Yes!" Came the year 1899, and with it more of the 115's—Nos. 120-1, 123-128, and 130-1, and then, oh! and then, *Princess of Wales* sailed into our ken! Here was a super-single-wheeler, and no mistake! Still the same old familiar and well-loved outlines, but grown now to really majestic proportions. And an eight-wheeled tender to complete the picture! A mighty thing it was—no wonder it could hold seven tons of coal and 4,000 gallons of water! We eagerly scanned the new engine, delighted with its harmonious outline, especially that of the long top line of the boiler, now that the dome was shifted back in vertical line with the driving axle. A worthy engine indeed to represent the fine old Midland Railway at the Paris Exhibition of 1900 (while she was there her nine sisters, Nos. 2602-8 and 22 and 23, were constructed). So she stood in the gay capital as her forbear, No. 1853, had stood eleven years previously.

On this occasion *Edward Blount* was, of course, not of the company—she was still in her prime dashing about the Brighton system. Instead, quite close to her, was an unusual (though handsome) North Eastern engine, a big 4-6-0 numbered 2006. Why do I mention this so particularly? Well, it is a wise man indeed who can see the future. How could one have guessed at that moment how quickly the single-wheeler was going to fade out of the picture? Were we not surrounded with magnificent examples of the type—Ivatt's big G.N. 266, the Great Central Pollitt 967, the Midland *Princess of Wales*, Dean's G.W. *Lord of the Isles*, to say nothing of Stirling's 1008, and Stroudley's wonderful *Grosvenor*? But in a year or two they were to be as extinct as the dodo, for, aided by finer steel rails and tyres, N.E.R. 2006 was the herald of a type destined to sweep away from the best work all our old friends at one fell swoop. What a significant quartet of engines was gathered at Paris in 1900!




*Plan of crank axle and outside axlebox of both Nos. 115 and 2601*

The Webb compound, *La France*, almost the last of her race, although a brand new locomotive (how soon, too, the N.W.R. compounds were to fade away!) and the lovely G.E.R. *Claud Hamilton*, destined for a magnificent career extending even to the present day. Two already doomed, and two pointing stoutly to the future; and even the two lucky ones as yet not dreaming of the next startling development—the coming of the super-heater and mechanical lubrication—so close at hand. So we leave our "lovely" at Paris. Only her wheels and crankshaft remain now at Derby. But (*Continued on page* 583)

# Lapping Involute Gears

*by S. A. Stead, B.Sc. (Jamestown, S. Australia)*

GEAR cutting proves somewhat difficult for the amateur with limited equipment, but Mr. Ian Bradley's article, published in THE MODEL ENGINEER, several years ago, provided some very useful advice. However, the present writer found the gears produced by these methods were defective, due to the lack of accurate measuring instruments, but in building an electric mains clock, was able to solve the problem by a simple lapping process.

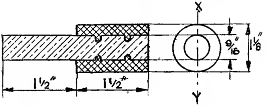



*Fig. 1. Lead lap cast on rod ready for screwcutting*

To make the lap, a number of ⅛-in. holes were drilled around the circumference of one half of a 3-in. length of $\frac{9}{16}$-in. brass screw rod, to provide a key for the lead to be cast on later. This end of the rod was thoroughly tinned, set upright on a flat surface, and surrounded by 1½ in. of 1⅛-in. brass tubing, which was previously blackened on the inside by holding it over a smoky paraffin flame, to prevent the lead from adhering to it. After heating the rod, molten lead was poured around it. When cool, the lead was turned down to 1 in. diameter (see Fig. 1), and screw-cut to a pitch which would mesh with the gears to be lapped. In the writer's case, the gears were approximately 60 d.p., and the pitch chosen was 20 t.p.i. The form of the tool, shown in Fig. 2, is for gears having a pressure angle of 14½ deg., in other words, the included angle is double the pressure angle of the gears. The tool is ground with a flat top, and is used to cut the thread shown. Depth is not important, so long as the lap will mesh with the full depth of the teeth, one face of each tooth being lapped at a time.

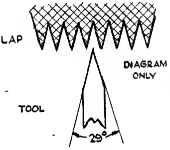



*Fig 2. Tool used for cutting thread in lead lap*

The teeth of the gears were left a little too thick, to allow for correction during lapping, but they were cut to the correct depth, as this factor was found more difficult to correct. During the lapping, the gears were free to rotate about an axis, almost vertical, but tilted slightly to bring the teeth faces parallel to the threads of the lap. Doubtless, readers could readily devise a suitable holder to clamp in the lathe tool-post, but double coned bearings are to be recommended, as they provide freedom of movement without allowing chatter.

When it would rotate freely, the gear was fed in to mesh lightly with the lap at one end. A paste of carborundum and paraffin was applied to the lap and, with the lathe running fast, the gear was fed in to mesh the full depth of the teeth. Irregularities of the teeth may cause small shavings of lead to be scraped off the lap, but so long as the amount was small, this gave no cause for concern, as there is plenty of lap and, as the form is corrected, very slow longitudinal feed may be applied to make use of the undamaged threads. It was found that light pressure applied to the top of the gear to produce a braking effect caused faster cutting. After a time the gear was turned over and the other faces of the teeth were lapped for the same length of time in the same manner as before. The correct amount of lapping is a matter of judgment, and can be determined by meshing the gears in pairs. This may seem a little crude, but it must be remembered that the gears will run together, and the method gives satisfactory results—that is the real test of any work.

If gears, wider than about $\frac{1}{16}$ in., are to be lapped, then it would appear that the whole face of each tooth could be corrected by the use of the vertical slide to raise the work slowly as the process continues.

This method is a true generating process, and quickly corrects the tooth form of clock or other small gears, leaving the teeth faces with fine surface, provided that the carborundum used is sufficiently fine. In the case of small gears, only one cutter is required for each pitch; it is unnecessary to make a full set of cutters of true involute form. As the writer has not had cause to produce larger gears, the method has not been applied to them, and no recommendations can be made at this stage, but it would seem that the same methods could be applied, but that a set of involute cutters would be necessary to avoid undue waste of time.

Incidentally, it may be mentioned that before this method was tried out, the necessary tool had been ground to cut two worms for use with the gears being produced, and this was considered to be the ideal shape for the threads of the lap.

# *A Tandem Compound Engine

## by "Crank Head"

HAVING described the cylinder drains and the method of operating them, a short description of the levers, and method of mounting them would appear to suggest itself. Fig. 25—A illustrates the bracket on which the levers are mounted in end view, and B the three levers assembled, as seen from the front. The bracket C is fabricated from a piece of steel plate $\frac{1}{8}$ in. thick, having a piece of $\frac{3}{8}$ in. round steel which forms the boss carrying the pin on which the levers are hinged brazed on one edge. The piece of plate was squared up on all edges, and lines drawn through the centre at right-angles to one another as at E and F. On one of the long sides, the piece of $\frac{3}{8}$ in. round steel mentioned was brazed, having been previously grooved to fit the edge of the plate, as described in the building up of the pedestal for governors. The brazing completed, the plate was placed in the vice and the pieces marked sawn out, the saw cut being made to within $\frac{1}{4}$ in. of the centre-line E. The portion carrying the boss for levers was now bent to an angle of approximately 45 deg., whilst the end portions were bent in the opposite direction to fit over the edge of the engine bedplate. The end elevation of the bracket is now as shown at J, fig. 25. The hole for pin is now marked off and drilled, and the portion cut out from the boss and bracket to accommodate the centre lever.

The levers were next made. A piece of $\frac{3}{8}$ in. square mild-steel provided the necessary material, and the blanks were clamped side by side in the machine vice, and roughed down to shape in the shaping-machine. They were finished by filing, and the handles were turned, bosses and forked ends drilled, and then mounted on a mandrel in lathe, and the centre bosses were turned up. The fulcrum pin on which the levers swing was made long enough to carry all three levers

*Continued from page 560, "M.E.," May 1, 1947.

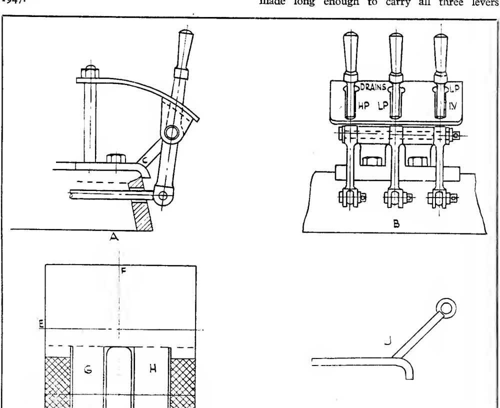
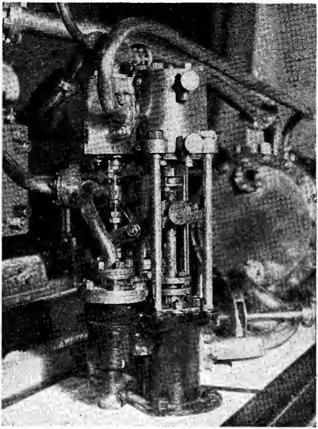



*Fig.* 25

and the brackets carrying the brass rack in which the levers work, and which also has engraved on it letters indicating what the levers control (B, Fig. 25). It will be noted that the lever on the right is marked L.P.I.V., which being interpreted means nothing more than "low pressure impulse-valve!"



*The main feed pump*

For the benefit of readers who may not be familiar with steam engines, a description of the function of the impulse-valve may be interpolated here. In engines using steam expansively, where steam is always admitted to the H.P. cylinder first, there is a possibility of the engine stopping with the H.P. crank on one or other of the dead centres, when in this position, admission of steam to that engine would fail to move it, so provision is made to enable a small jet of H.P. steam to be admitted to the (in a compound engine) L.P. cylinder. This moves the engine slightly, and, of course, allows the H.P. cylinder to function in the normal manner. This explanation would only be applicable to an engine with each cylinder operating on a separate crank, and would not apply to the engine being described. The reason for fitting the impulse valve to an engine of the type under description is this: With the valve-gear which is fitted to the H.P. cylinder and controlled by the governor, it is possible for the engine to stop in a position where the expansion-valve covers both ports in the main valve, thus preventing any steam passing into the H.P. cylinder. It is then that the impulse-valve is used, passing a jet of boiler steam, or rather steam at boiler pressure, into the L.P. cylinder, which steam would move the engine sufficiently to open the port in the H.P. valve.

Fig. 26 illustrates the impulse-valve, and actuating gear as fitted to the model, the sketches of the various parts are not in correct proportion; this was done for the sake of clarity, the external dimensions of the actual valve chest being 1 in. × ¾ in. × ⅜ in. This valve and the actuating gear are not visible in either of the photographs, the only view to be seen is in the photograph taken from the back of the engine; a small portion of the vertical shaft operating the valve can just be made out behind the feed pump and on its right side.

The impulse-valve chest is mounted on the L.P. main valve-chest as shown at A, Fig. 26, and is just a plain slide-valve working over a small rectangular port cut in the main valve-chest. In A, the valve is shown in its closed position. As previously explained, its function is to admit a small quantity of steam at boiler pressure to the L.P. cylinder. In the manufacture of this valve, the remains of the railings previously mentioned again provided the material for the valve-chest; this was marked off with a boss at each end to provide stuffing-boxes for the valve-spindle, and the centre portion drilled out as near to size as possible. The valve-chest was then filed to shape and size, both internally and externally. The centre-line of the valve-spindle was then marked off and the box mounted on an angle-plate in the lathe, one stuffing-box machined up, and the hole for the spindle bored. The box was then turned end-for-end and set up to run truly with the centre previously marked off, and the other stuffing-box drilled and machined. It was originally intended to drill the hole for valve spindle in both ends at one setting in the lathe; but, as the diameter of the tail end of valve spindle is 3/32 in. it was soon found that the method intended was going to lead to trouble, so the job was done in two settings, it took a bit longer, but proved to be worth the extra trouble involved.

The valve-spindle itself is ⅛ in. in diameter, and screws through a bronze nut which is a sliding fit in the slot in which it is held, and which is cut in the back of the valve. Once again, the hole in the valve through which the spindle

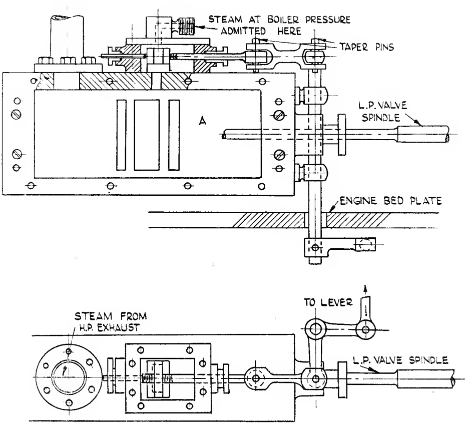



*Fig.* 26

passes is elliptical, with all the clearance on the back of the valve, to enable the high pressure steam to assist in keeping the valve on its face, and so prevent a leakage of high pressure steam into the L.P. cylinder should the stop-valve connected with the H.P. steam line be leaking.

The valve-chest is secured to the L.P. valve-chest by eight 3/32 in. studs, which studs also secure the cover.

The sketches, it is hoped, indicate pretty clearly the gearing for operating the valve ; all the forked rods, and cranks are made from the solid and, where necessary, pinned to the various rods by taper pins. It will be noted that the short connecting-rod which is connected to the valve-spindle, and the lever on the vertical spindle are fitted with tapered pins instead of the orthodox parallel pins having cheese-heads, and split pins. This is necessary on account of the limited amount of room.

Fig. 26 also shows the valve-chest and valve in plan, with the cover removed. The elbow admitting steam to the valve, as shown in the sketch A, is a piece of gunmetal, screwed into the valve cover, and screwed and bored at the other end to accommodate an ordinary conical union joint. The steam supply for the valve is taken through the small screw-down valve, situated alongside the regulator-valve, seen in the photograph showing the plan of the engine.

The method of attaching this small valve to the main steam pipe might be of interest as it was required to be able to admit steam to the impulse-valve without opening the main regulator-valve. A thick brass washer, the diameter of which was equal to the diameter of the flange at the inlet of the main regulator-valve was made, and holes marked off to correspond with the bolt-holes in the flange of the regulator-valve. A dove-tailed shaped piece was then cut out of the washer nearly penetrating to the bore of same, as in Fig. 27. A piece of brass wâs then made to fit this slot, and left long enough to secure the small stop-valve to, particular care being

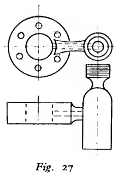


*Fig.* 27

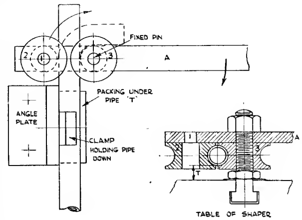



*Fig.* 28

taken to see that the dovetail did not break into the bolt-holes. A $\frac{1}{8}$-in. hole was then drilled axially through the piece which had been fitted and penetrating to the bore of washer, the protruding portion was then turned to a diameter suitable to the hole which had previously been drilled in the body of the small stop-valve; the whole was then assembled and silver - soldered at one heating. When cold, the whole fitting was mounted on a mandrel and both sides of the washer faced up, and the bolt-holes previously marked off were drilled.

The outlet end of the small stop-valve, which had previously been screwed and bored for a conical union joint, was then set up in a piece of metal mounted in the chuck, and the interior of valve-body, valve seating etc. machined up ready to receive the valve-spindle, and the bonnet of the valve.

Fig. 28 illustrates the gear used to bend the steam and exhaust pipes, and consists of, A, a piece of flat bar steel with a series of holes drilled in it; the sketch shows only two. No. 1 is a hole $\frac{5}{16}$ in. diameter into which a pin is tightly driven, the body of the pin being $\frac{3}{8}$ in. diameter which is a working fit in the roller 2. Around the periphery of this roller is turned a nearly semicircular groove which is of a radius equal to the external diameter of the tube to be bent. 3 is a roller similar in all respects to 2. The second hole in A is pitched in such a position that when a bolt is put through the hole, and with roller 3 on it, the tube to be bent will just pass through the groove in the rollers. The bolt on which roller 3 revolves is securely screwed into the bench, or whatever may be used to support the gear; in this instance, it was the table of the shaper. The tube filled with lead (by the way, prior to running the molten lead into the tube for about $\frac{1}{4}$ in. from the end, as this prevents the lead being squeezed out when bending, particularly if the bend is near the end of the tube; and always warm the tube before pouring in the hot lead) is passed between the rollers, with a bit more than the length of the finished bend protruding. An angle-plate is then bolted down on the bench as close to roller No. 2 as possible, a suitable piece of packing is placed under the tube to compensate for the thickness of the thin nut, see T, and a clamp bolted on the angle-plate to hold the pipe down firmly on the packing; lever A is then pulled round in the direction shown, and the pipe naturally follows.

A little juggling with the angle-plate when the lever comes around parallel with it may be necessary; for it pays to pull the bend round a little more than necessary, particularly if the tube is thin-walled, for then there will most likely be a few small puckers on the inner side of the bend which must be dressed back by hammering, a process which has the effect of opening the bend out a little.

(*To be continued*)

# Locomotives Worth Modelling

(*Continued from page* 578)

sometimes I *do* wish I could see her again, just for a moment!

### Useful Dimensions

*The* 115 *Class.*

Cylinders $19\frac{1}{2}$ in. by 26 in. Ports $17\frac{3}{4}$ in. by $1\frac{3}{8}$ in., Lap $1\frac{1}{8}$ in. Lead $\frac{1}{8}$ in. Travel $3\frac{11}{16}$ in. Piston valves, 8 in. dia. by $2\frac{1}{2}$ in. Distance apart, 12 in. Length of ecc. rods, 4 ft. $3\frac{7}{8}$ in. Length of connecting rods, 6 ft. $3\frac{1}{2}$ in. Inclination of cylinders and valves (above and below) 1 in 16. Diameter of boiler lagging, 4 ft. 7 in. N.B.—All the above apply also to *Princess of Wales*. Bogie wheels, 3 ft. $9\frac{1}{2}$ in. Trailing wheels, 4 ft. 4 in. Wheelbase: Bogie, 6 ft. Bogie pin to driving axle, 10 ft. $2\frac{1}{2}$ in. rear, 8 ft. 9 in. Front overhang, 2 ft. 6 in., rear overhang, 4 ft. 2 in. Height of cab roof above rails, 11 ft. 5 in. Height of chimney, 3 ft. Height to top of platform, 4 ft. $3\frac{5}{16}$ in.

"*Princess of Wales*" *Class.*

Bogie Wheels, 3 ft. 10 in. Driving, 7 ft. $9\frac{1}{2}$ in. Trailing, 4 ft. $4\frac{1}{2}$ in. Wheelbase: bogie 6 ft. Bogie pin to driving axle, 10 ft. $2\frac{1}{2}$ in., rear axle, 9 ft. 9 in. Front overhang, 2 ft. 6 in. Rear overhang, 4 ft. 2 in. Length of boiler, 10 ft. 6 in., length of firebox, 8 ft. Height of cab above footplate, 7 ft. $1\frac{1}{2}$ in.

Tender: Bogie frames (1 inch) 6 ft. apart. Width of tank, 7 ft. Width over coping, 8 ft. Width over footplate, 7 ft. 7 in. Journal centres, 6 ft. 6 in. Total wheelbase of engine and tender, 49 ft. $7\frac{1}{4}$ in.

# "L.B.S.C."

# "HIELAN' LASSIE'S" SUPERHEATER

THE superheater, which is of the multiple-element firetube type, follows full-size practice, being a simplified edition of that used on full-sized locomotives; and any unprejudiced person who compares it with the ludicrous attempts at "superheating" (? condensing!) by means of coils, or "grid-irons" of tube, located in the smokebox, cannot fail to realise that we have indeed made some progress in recent years, and have moved with the times, as Mr. George Archer truly stated in his letter. There are three distinct sections in the "Lassie's" superheater assembly, viz., the wet header, which carries the vacuum relief or snifting-valve, and which is attached to the flange of the main steam pipe; the four elements, which reach to the combustion chamber; and the hot header, from which diverge the pipes conveying the hotted-up steam to the cylinders.

We will kick off with the elements first. Four pieces of ¼-in. by 20- or 22-gauge copper tube approximately 13 in. long, are needed for the upper members, and four ditto 12¼ in. long for the lower. One end of each longer piece is bent to a right-angle, as shown. I explained how to make these bends when dealing with the exhaust-pipes, so there is no need for repetition. The leading ends of the shorter tubes are left straight. The rear ends may also be left straight until the block return bends are brazed on.

To make the latter, four small blocks of copper are needed, measuring approximately ½ in. by ⅝ in., and about ⅜ in. in thickness. On one of the long sides, make two centre-pops a little over ¼ in. apart, and drill these to a depth of ⅜ in., the two holes converging so that they break into each other just inside the edge; see sectional illustration. Use letter D drill if you have one, which is a tight fit for the ¼-in. pipes; if not, use ¼-in. Insert one bent pipe and one straight pipe into the holes, letting them go in about ⅛ in.; then braze the joints. Don't use silver-solder on this job; either brass wire, brazing strip, or better still, our old friend, Sifbronze, will do the doings. Quench in acid pickle, wash, and clean up; file the blocks to the shape shown in the illustration, and then bend the tubes so that they are parallel from just outside the return bend, to the other ends. If any builder prefers making spear-heads to block bends, he can do so; they will be just as satisfactory. The main reason why I now specify block bends, is because I have had so many complaints about beginners getting the spear-heads bunged up when doing the brazing. It would puzzle them to bung up the holes in the block, even if they wished, as long as the pipes are a good fit in the holes.

## Wet Header

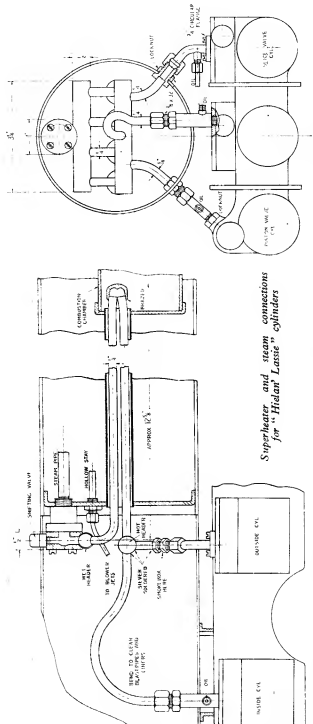
A casting may be provided for the flange, in which case it will need only facing and drilling as below. If not, chuck a piece of 1-in. round brass rod in the three-jaw; face the end, centre, and drill down ⅜ in. depth with 9/32-in. drill. Part off at ½ in. from the end; if a casting is used, reverse in chuck and face the other side, to give the screws a smooth bed for their heads. File a half-round groove a full ⅛ in. deep in the edge, with a ½-in. round file; or put the header flange under the slide-rest tool-holder and run it up to the side of a ½-in. end-mill in the three-jaw. At the bottom of the semi-circular groove, drill a 9/32-in. hole, breaking into the blind centre hole. Never mind about the snifting-valve hole for the nonce, as Bill Spokeshave (of the Stratford where they didn't build any "Petroleas") might have remarked.

The next requirement is a piece of ½-in. by 20-gauge copper tube, 3¼ in. long; in the middle of this, drill a 9/32-in. hole, and then, diametrically opposite (now *isn't* that stylish?) drill four holes at ⅞ in. centres, as indicated in the end view, so that they come opposite the flues. Use letter D or ¼-in. drill, same as for block bends. Plug each end of the tube either with discs of 3/32-in. sheet copper, or a couple of slices parted off a piece of brass rod turned to a tight fit in the tube. Fit the four bent-up ends of the elements into the four holes; tie the flange to the top of the header tube with some thin iron binding-wire, or hold it in place with a brazing clamp, and silver-solder the whole issue—flange, tubes, and ends of header tube—at one fell swoop. I've described silver-soldering jobs so many times, that followers of these notes should be able to do this job without any further detailed instructions. Silver-soldering is quite O.K. for the joints in the superheater at the smokebox end, as it is well away from the fire; and the joints will be of ample strength.

## Hot Header and Distribution Pipes

The hot header is an exactly similar piece of ½-in. tube to that used for the wet header, with four holes for ¼-in. tubes at ⅞-in. centres, and plugged ends. Now diametrically opposite (bless my soul, there we go again!) and right in the centre, drill another hole for ¼-in. tube; the pipe feeding the middle cylinder goes in that one. The two pipes for feeding the outside cylinders are attached at the bottom; and note carefully—the composite illustration shows the rig-up for both piston-valve cylinders and slide-valves. That on the left is for piston-valves, and that on the right is for slides. The steam-pipe hole for the former is drilled approximately ⅞ in. from the end, and for the latter ½ in.

Two brass fittings are needed, to poke through the sides of the smokebox. To make these, chuck a bit of ½-in. hexagon—or round will do at a pinch—brass rod in three-jaw; face the end and centre deeply; drill down about ⅝ in. depth with 13/64-in. drill. Turn down ½ in. of the




*Superheater and steam connections for "Hielan' Lassie" cylinders*

outside to $\frac{3}{8}$ in. diameter, and screw $\frac{3}{8}$ in. by 32; part-off $\frac{5}{8}$ in. from the end. Reverse in chuck, and open out the hole for about 3/32 in. depth with letter D or $\frac{1}{4}$-in. drill. Fit a short piece of $\frac{1}{4}$-in. tube in each, as shown in the illustration, 1 in. for slide-valve cylinders, and $1\frac{1}{4}$ in. for piston-valve cylinders. Silver-solder the tubes to the fittings, bend slightly as shown, and insert in bottom holes in the hot header. The pipe for feeding the inside cylinder is approximately $6\frac{1}{2}$ in. long, $\frac{1}{4}$ in. diameter, and carries a $\frac{3}{8}$-in. by 32 union nut and cone on its outer end. The inner end is fitted into the middle hole in the hot header; the four straight members of the elements are also fitted into the four holes in the back of the header, and the whole of the joints silver-soldered at one heating as before. That completes the superheater itself; not such a terribly hard job after all, is it?

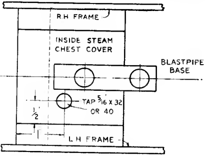
## Connecting-pipes for Slide-Valve Cylinders

First of all, attach the wet header temporarily to the steam-pipe flange. Drill four equidistant holes, $\frac{1}{8}$ in. from the edge, clean through the wet header flange with the No. 34 drill, at the positions indicated by the slotted screw-heads in the end view. Then put the elements in the flues, and butt the contact faces of the flanges together, so that they line up exactly. Poke the 34 drill through the holes in the header flange and make countersinks in the steam-pipe flange; remove wet header, drill countersinks No. 44 and tap 6-B.A. Replace superheater, and hold temporarily in position by two screws in the header. Measure distance from edge of boiler barrel, to centre of side steam-pipe fittings; transfer this to smokebox, and drill a 13/32-in. hole each side, same distance from back edge of smokebox and approximately 1 in. above bottom for slide-valve cylinders, and $\frac{5}{8}$ in. for piston-valve cylinders. Remove superheater, put smokebox on boiler temporarily, and replace, with the fittings projecting through the two holes. Take the nozzles off the blastpipes, and place the boiler temporarily in position on the chassis. The blastpipes through the holes in the bottom of the smokebox will locate the longitudinal position, and the bottom of the smokebox shell should rest on the blast-pipe base, $\frac{7}{16}$ in. above top edge of frame at that point.

Now, if you take a good look at the end view, which gives one of the steam pipe connections in part section, you'll be able to pertwig the

whole arrangement without the least trouble. A lock-nut goes over the projecting part of the screwed fitting and holds it tightly in position; but you don't fit that "for keeps" until the boiler is erected on the chassis, also "for keeps." A circular flange, of $\frac{1}{8}$-in. brass plate, and $\frac{3}{4}$ in. diameter, is attached to the top of the steam-chest by three 3/32-in. brass screws. A hole is drilled in the middle (letter D or $\frac{1}{4}$-in.) and a short bit of bent $\frac{1}{4}$-in. copper pipe is silver-soldered into it. The other end is furnished with a union nut and cone, to attach to the fitting sticking out from the smokebox.

Just above the circular flange, a small union screw, exactly the same as fitted to the clacks under the mechanical lubricator, is silver-soldered into the pipe, to take the oil-supply pipe. These will be described, all being well, in the next instalment, I don't think any special instruc-

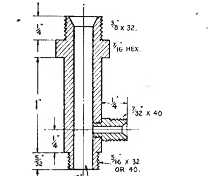



*Location of fitting for inside cylinder*

tions are needed for making up this simple fitting, for it is merely a matter of trial and error. Make the flange first; a $\frac{1}{8}$-in. slice parted off a $\frac{3}{4}$-in. rod will do, or a circle of $\frac{1}{8}$-in. plate. Drill centre hole, and three No. 41 screw-holes. Silver-solder in a short bit of pipe; bend as shown, "offer it up" to the job, as the locomotive fitting shopmen say, and cut off flush with the screwed fitting. Make the union nut and cone, as given in previous instructions; fit the cone to the pipe, and have it of such a length that when the flange, resting on the steam-chest cover, is slid across it towards the smokebox, the cone enters the countersink in the fitting. The oil nipple is merely a kiddy's practice job, and the whole lot—flange, nipple, and cone, is silver-soldered at one heat. Mark the spot where the flange seats on the steam-chest cover; drill a $\frac{1}{4}$-in. hole in the middle, and attach the flange, as mentioned above, locating the screw-holes as described for the header joint, cylinder covers, and other flanged components. Don't leave any chippings in the steam-chests!

## Variation for Piston-Valve Cylinders

The chief difference for piston-valve cylinders is that no flange is needed. Cut a straight piece of $\frac{1}{4}$-in. pipe about $1\frac{1}{4}$ in. long, fit a union nut and cone on one end, an oil-nipple about half-way down, and screw about $\frac{3}{8}$ in. of the other end $\frac{1}{4}$ in. by 40, putting on a lock-nut. Tap the boss on the piston-valve steam-chest $\frac{1}{4}$ in. by 40, and screw the pipe in as far as it will go. When the boiler is erected "for keeps," the pipe is run out from the cylinder until the union-cone seats in the socket of the fitting projecting from the smokebox, the union-nut tightened up, and the lock-nut run back against the boss on the steam-chest, with a smear of plumbers' jointing

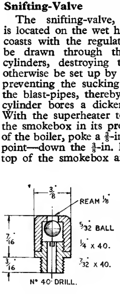



*Steam and oil fitting for inside cylinder*

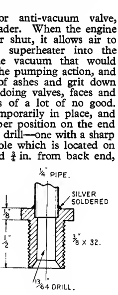
on the threads, and two or three turns of flax or hemp between nut and boss. The oil-nipple should point towards the front of the engine.

## Snifting-Valve

The snifting-valve, or anti-vacuum valve, is located on the wet header. When the engine coasts with the regulator shut, it allows air to be drawn through the superheater into the cylinders, destroying the vacuum that would otherwise be set up by the pumping action, and preventing the sucking of ashes and grit down the blast-pipes, thereby doing valves, faces and cylinder bores a dickens of a lot of no good. With the superheater temporarily in place, and the smokebox in its proper position on the end of the boiler, poke a $\frac{3}{8}$-in. drill—one with a sharp point—down the $\frac{3}{8}$-in. hole which is located on top of the smokebox and $\frac{3}{4}$ in. from back end,




*Snifting valve*




*Union screw for outside cylinder*

and make a countersink on the wet header flange. Remove the superheater, drill out the countersink with $\frac{3}{16}$-in. drill, breaking into the blind hole in the header flange, and tap it 7/32 in. by 40. That ensures the snifting-valve lining up with the hole in the smokebox, and incidentally reminds me of a funny story. On one of his

visits to Swindon, Mr. J. C. Crebbin happened to discover the derelict boiler of the "Great Bear" in the scrap yard, and stood up in the smokebox with his head through the chimney hole. Somebody with a small camera took a shot of it, and when one of the little prints (about the size of a matchbox label) was shown at a club meeting, one of the members remarked "Well, I never knew before, that the "Great Bear" had a snifting-valve on the smokebox!" Some snifting-valve, at that!!

"Lassie's" snifting-valve is shown in the small detail sketch. Chuck a piece of 3/8-in. round rod—bronze or gun-metal for preference, but brass will do if nothing better is available—face the end, centre, and drill No. 40 for a full 3/8 in. depth. Turn down 3/16 in. of the outside to 7/32 in. diameter, and screw 7/32 in. by 40. Part off at 5/8 in. from the end; reverse and re-chuck in a tapped bush held in three-jaw, then turn down 1/8 in. of the end to 1/4 in. diameter, and screw 1/4 in. by 40. Cross-nick the end as shown. Re-chuck the bit of rod; centre, drill down about 1/2 in. depth with No. 34 drill, open out to 1/4 in. depth with 7/32-in. drill, and bottom the hole to 5/16 in. depth with a 7/32-in. D-bit. Slightly countersink the end of the hole, and tap 1/4 in. by 40, taking care not to spoil the D-bitted seating. Part off a full 5/8 in. from the end; reverse in chuck, poke a 1/8-in. parallel reamer through the centre hole, and round off the end. Drop a 5/32-in. rustless steel ball into the cup, seat it in the usual way with hammer and brass rod, then assemble as shown in the illustration. The ball needs more movement than a clack ball, so that when the regulator is opened, the rush of steam can smack it up against the seating with an audible click, and so make quite certain that it seats tightly without allowing steam dribble. The snifter is not fitted "for keeps" until the boiler is erected ditto.

**Steam Connection for Inside Cylinder**

The fitting for connecting up the inside cylinder to the superheater is shown in both side and end views of the complete assembly; and the location is shown in the small plan, at the left-hand side of the blastpipe base, and level with front of same. Drill a 9/32-in. hole at the spot indicated, 1 in. from the front of the cover, and 1/2 in. from the left-hand side; tap it 5/16 in. by 32 or 40. To make the fitting, chuck a piece of 7/16-in. hexagon brass rod in three-jaw, face the end, and turn down 5/32 in. of the outside to 5/16 in. diameter, screwing 32 or 40 to match the tapped hole in the steam-chest cover. Turn down a further 1 in. to 3/8 in. diameter, and part off at 1 5/8 in. from the end. Reverse in chuck; turn down 1/4 in. of the other end to 3/8 in. diameter, and screw 3/8 in. by 32. Centre deeply, and put a 13/64-in. drill clean through.

At 1/4 in. above the bottom shoulder, drill a No. 30 hole and tap it 5/32 in. by 40. Make a little nipple to screw into this, from 1/4 in. hexagon or round brass rod, same as fitted to mechanical lubricator outlets, except that the small end, or pip, is screwed into the fitting instead of being silver-soldered. You *can* silver-solder it if you wish, but in that case you'll have to take off the blast-pipe base, temporarily, to screw it into the steam-chest cover, As shown, the fitting is screwed home into the steam-chest cover first, then the oil-nipple screwed into the side of it, putting a smear of plumbers' jointing on the threads of both. Beginners want to know what plumbers' jointing is; well, it's just a compound with a white lead and linseed oil base which renders the threads steam and water tight, and is sold under various proprietary names (Boss White, Templar's Jointing, etc.) in small tins at all ironmongery and similar stores selling plumbers' requisites. A shilling tin lasts years on our job.

To connect up to an inside piston-valve cylinder, make up a similar pipe to that used for the outside cylinders, screwing the end of it 1/4 in. by 40, and fitting a lock-nut, also silver-soldering an oil-nipple into it. Instead of the upper end carrying a union nut and cone, make another fitting like those sticking through the sides of the smokebox, and silver-solder it to the upper end of the pipe. Screw the lower end of the pipe into the boss on the steam-chest, which is on an angle, same as those of the outside cylinders; lock up the nut, and then bend the pipe so that the screw fitting is vertical. The union nut on the swan-neck connecting it to the hot header, can then be attached in the same way as illustrated for the slide-valve cylinder. Now, before any of the above blobs and gadgets are permanently fixed, we have to make the grate, ashpan, and smokebox-saddle, and erect the boiler; so that, with blower jets and the oil connections, will be dealt with, all being well, in the following instalments.

# The "Yankee Shop" Catalogue

WE have received from Mr. L. D. Friend, 88, High Street, Danvers, Mass., U.S.A., his locomotive catalogue for March, 1947. This is a real "live steam" production, especially for those engaged in, or contemplating the construction of any American-type locomotives. It not only gives photographs of the completed models, and in some cases of the chassis during construction, but lists in detail the prices of the drawings, castings, and components. There are also photographs of the "Yankee Shop" with its well-equipped interior, of several machining jobs in progress, and, not the least interesting, Mr. L. D. Friend himself at the drawing board, drafting the details of "Judy." Mr. Friend is well known as the President of the New England "Live Steamers," and his catalogue indicates that a first-class supply service is available to all small-power locomotive constructors, particularly in 3/4-in. scale. A novelty is the "Tom Thumb" locomotive, with vertical engine and boiler, particularly recommended as a first effort. It is on a 4-wheel truck and will pull a man or two boys.

# Letters

### Spray Painting

DEAR SIR,—Whilst looking through some back numbers I came across H. W. Porter's (5-10-44) notes on "Painting for Amateurs," and since, in a recent issue, there has appeared a spray gun of good type and balance for the amateur and professional alike.

Should it be the wish of any of the clan to try out the finishes of cellulose, a reasonable skill is easily acquired from practice with a very small percentage of failures, if one or two common-sense rules are observed.

(1) Putting or spraying cellulose thick will make your job look sick.
(2) Sprayed too thin, soon an empty tin.
(3) At the first sign of a run put down your gun.
(4) As in most things, equality works well, 50/50 cellulose and thinners with the same or slightly higher air pressure.

As necessary skill is obtained so can proportion be increased to 65-75/25 air, cellulose/thinners.

Spraying primer filler as a base, will be found, I think, the best way for the amateur and to flat or rub down or up whichever way is desired with 360's or 400's waterproof paper (abrasive) using a little soap with same for lubrication and cleaning purposes, for filler and cellulose will stick to the paper and cause scouring and scratches that are fatal to the finish.

Cellulose has a habit of sinking and making prominent scratches in previous coats or under-coating. If a more durable surface and slower drying is required, add a small amount of castor oil, dependent upon the requirements of the sprayer and work to be done.

To obtain the best results, flat or rub each coat, do not rub heavily projections or corners. Flat last coat then spray 25/75 cellulose/thinners lightly and quickly over all, polish if desired.

This applies also to large area work and is really not quite the present-day method, that is apt to skimp rather than finish the job.

Yours faithfully,
Silsden. T. B. SMITH.

### Cutting Square Threads

DEAR SIR,—The problem mentioned by "Plant and Maintenance," THE MODEL ENGINEER, 20-3-47, Vol. 96, p. 356, is a most interesting one and can, the present writer thinks, be overcome in several ways.

It is unfortunate that he does not give fuller details as to the length of nut required, material it is to be made of and efforts already made to cut the threads. Also, definite diameter and threads per inch required on same. However, assuming he requires the length of his nuts twice the diameter of the screws and they are made in cast-iron, phosphor bronze, or brass. These materials are much easier to work because the chips break off short. He particularly mentions square threads, but has he considered using Acme threads? These are definitely superior if there is no possible objection to their use.

Has he tried using the tool upside down and cutting on the back of the hole? This is a very helpful and effective measure. Further, is it necessary to have a full depth of thread on such small diameter screws? Why not have a modified form of thread, either square or Acme, by boring a larger hole and having a shallower thread. The thread would be of ample strength.

A solid tool is best, as it gives the maximum clearance for the chips. But it must be carefully made to get the maximum amount of strength, and the clearance behind the cutting edge must be very carefully ground, not too much clearance but just enough. Side clearance must also be carefully watcned, especially if it is a coarse-pitch screw. Very small boring-bars could be used with tiny tool-bits, but I think solid tools are to be preferred. The section of the boring tool could be made an oval, this will give added strength.

The writer recently had to screw over 150 nuts, $\frac{1}{2}$-in. Whitworth, and the thread was $2\frac{1}{16}$ in. long, the material was S.11, a nickel steel, and tapping in the ordinary way was not successful, so they were screw-cut in the lathe, leaving the least possible amount for the sizing tap.

Regarding his suggestion of a bar supported each end, while the bar would be very strong and rigid, it would be quite impossible to so arrange such a tiny cutter as would be required, so that it be advanced between each cut and then locked.

Yours faithfully,
Wembley J. H. DAVIS.

### Truing Up of S/C Chucks

DEAR SIR,—I have often read that as a preliminary to the work of truing up the jaws (either by grinding, or by annealing the jaws and turning), a circular piece should be gripped either by the very back of the jaws, or by the inner thread of the jaws. This is wrong advice.

If one jaw is out of truth, closing up on any round piece will bring the jaws eccentric, and thus vitiate any further process on these lines.

Accuracy lies between the scroll and the slide-rest; the jaws must be ignored.

Therefore close the jaws nearly on to a spinning emery pencil (which can go comfortably into the bore of the chuck). Advance the jaws by the chuck key, start the lathe, traverse the spinning emery pencil, stop, advance the jaws a shade more, etc.

If the jaws are first marked with colour it can be ascertained visually when all jaws are on the circle of the emery pencil.

If the chuck is old, there enters the possibility of the scroll working back centrifugally; to prevent this use a "jubilee worm drive hose clip" round the chuck body.

I advocate the emery pencil moving accurately longitudinally, i.e., avoiding the taper the makers grind on the drill jaws; I appreciate why they do so.

In fitting a back plate to a chuck, after turning the register, use the back half of the chuck as a drill jig for the three bolts, first, however, marking the joint for reassembly. Others, Mr. Editor, help me, so I hope I have helped them.

Yours faithfully,
Bristol. J. C. DAVIS.